

**A Work Project, presented as part of the requirements for the Award of a Master Degree in  
Economics from the NOVA – School of Business and Economics.**

## **International trade in services in a globalised world**

**Birgitte Ringstad 816**

**6 January 2015**

**A Project carried out on the Master in Economics Program, under the supervision of José  
Albuquerque Tavares**

# **International trade in services in a globalised world**

This study focuses on international trade in services in an increasingly globalised world from two perspectives: the role of services in global value chains, using Norway as a case study, and the impact of regional economic integration and regulatory trade barriers on international trade in services.

Following Koopman, Wang and Wei (2014) and using the international input-output tables of the World Input-Output Database (WIOD) released in 2016, this analysis reveals that Norway's exports of services are higher than exports of manufactured goods if measured in value added terms. Using the Anderson and Van Wincoop (2003) gravity system, this study shows empirically that heterogeneous regulations across countries lower international trade in services.

## **Services, Value-added, GVCs, Gravity**

### **1. Introduction**

International trade in services has increased substantially during the 2000s as a consequence of declining entry barriers, regulatory reforms which have partially liberalized trade in services, and the introduction of information and communication technologies. Cross-border trade in services accounted for 21 percent of world trade in goods and services as of 2014, a share which is estimated to increase significantly if trade in services through commercial presence is included (WTO, 2015). Indeed, investments in services have increased even more than cross-border trade in services in the 2000s (WTO, 2015; UNCTAD, 2004). The increasing presence of trade in services is reflected in the significant contributions from services to gross domestic product (GDP) and employment in the world (Francois and Hoekman, 2010), which is echoed in the large contribution from the service sectors in value-added trade.

The share of services in total world trade increases substantially if measured in terms of value-added rather than gross terms, whilst the opposite result applies to manufactured goods. In Figure 1.1 we observe that services share grew from 27 to 45 percent when measured as value-added exports rather than gross exports in 2014. In contrast, the share of manufactured goods fell from 61 to 36 percent. The fact that trade in services is relatively larger and manufacturing relatively lower when measured in value-added terms is well documented in the literature (Francois et al., 2010; Francois, Manchin and Tomberger, 2015). For instance, Johnson (2014) shows that the shares in world trade of services and manufacturing account, respectively, for

around 20 and 70 percent when measured in gross terms in 2008. However, they account for approximately 40 percent each if measured in value-added terms.

Trade and production are increasingly organized within global value chains (GVCs), and a strong international fragmentation of manufacturing production has taken place during the 2000s (Timmer et al., 2014). As a result, countries’ exports increasingly rely on intermediate imports of goods and services that are sourced from domestic and foreign sources (Kowalski et al., 2015). Recent literature has found that the use of services as inputs in manufacturing has increased in line with international outsourcing by firms (Francois et al., 2008; 2010; 2015). Consequently, services have important functions as *linkages* in GVCs, which applies particularly to service sectors such as telecommunications, transport, distribution and logistics that facilitate transactions through space, but also to financial and legal services which facilitate transactions through time. Hence, the contribution from services in terms of direct and indirect domestic value-added in exports are essential (Francois et al., 2015, Miroudot, 2016). Throughout the analysis, *direct value-added* refers to export of service companies or sectors itself, and *indirect value-added* refers to exports of services of manufacturing components embodied as inputs in production of goods. Moreover, services have important functions in sales of goods and represent value-creating activities. The first refers to services sold together

**Figure 1.1. Sector shares in total world value-added and gross exports**



with a good to facilitate use of the latter, for instance, machines that are exported with installation, engineering, maintenance and repair services, whilst the latter could be research and development activities at the beginning of value chains which

creates additional value-added through increased productivity and innovation (Miroudot, 2016).

International trade in services is subject to trade costs in terms of regulations, which differ across countries, sectors and mode of supply. Importantly, and a focus point in this study, there are heterogeneous regulations across countries (OECD, 2014). Regulatory trade barriers are generated as a result of additional entry and operating costs associated with exporting. For instance, Kox and Nordås (2007; 2009) find that regulatory heterogeneity has a significant and negative impact on both market entry and trade flows of services through gravity estimations, and similar results are obtained in Marel and Shepherd (2013) and Nordås and Rouzet (2016). The interest in improved conditions for international trade in services has gained momentum during the 2000s, which has resulted in a substantial increase in the number of regional trade agreements that includes provisions on services (Roy, 2016). For instance, regulatory coherence and harmonisation are important elements in ongoing preferential negotiations such as the Trade in Services Agreement (TISA) and the Trans-Pacific Partnership (TPP) (Nordås et al., 2016; Baldwin, 2012).

This study focuses on international trade in services in an increasingly globalised world from two perspectives: the role of services in global value chains, using Norway as a case study, and the impact of regional economic integration and regulatory trade barriers on the flow of services. Section 2 introduces the concept of international trade in services, and gives an overview of regional economic integration and regulatory trade barriers. Section 3 evaluates Norway's value added exports and participation in global value chains during 2000-14 using the input-output framework in Koopman et al. (2014) and Timmer et al. (2013). The focus is on differences between primary, manufacturing and service sectors, and to what extent services are embodied in manufacturing and total gross exports. Section 4 provides an empirical investigation of the effect of regional economic integration and regulatory trade barriers on the flow of services across sectors using the gravity model by Anderson and Wincoop (2003). In

sum, the analysis answers the following research questions: (1) what role do services have in Norway's integration into global value chains; (2) how is trade in services influenced by regulatory trade barriers and regional integration?

### **2.1. Characteristics, measurement and data on international trade in services**

Services are given two particular characteristics; *proximity* and *inseparability* in production and consumption. The first implies that the producer and consumer must often be geographically located at the same location due to services' intangible or non-material nature, and the second means that production and consumption frequently must appear simultaneously because of the "non-storability" of services (Francois et al., 2010; Grünfeld and Moxnes, 2003). International trade in services has been classified into four modes of supply since the establishment of the General Agreement on Trade on Services (GATS): (1) cross-border supply of services; (2) consumption abroad; (3) commercial presence; and (4) presence of natural persons.<sup>1</sup> The share of each mode in world trade of services differ substantially. In 2014, they were estimated to be 30, 10, 55 and 5 percent, respectively (WTO, 2015).

Data on international trade in services has a lower quality than trade in goods and is often limited to data on cross-border trade and consumption abroad (Francois and Pindyuk, 2013). Indeed, data on trade in services has improved only in recent years, and this study uses the World Input-Output Database (WIOD) released in November 2016 and the Trade in Services Database (TSD) version 8.7 (Timmer et al., 2015; Francois et al., 2013). Section 3 uses harmonised world input-output tables from the WIOD for 44 countries and 56 sectors for the 2000-14 period, of these 30 are service sectors that include international trade through cross-border and consumption abroad. Section 4 uses bilateral data on international cross-border trade in services from the TSD, which is classified by sectors according to balance of payment (BOP) codes.<sup>2</sup>

---

<sup>1</sup> Further descriptions of the modes are given in Appendix A.

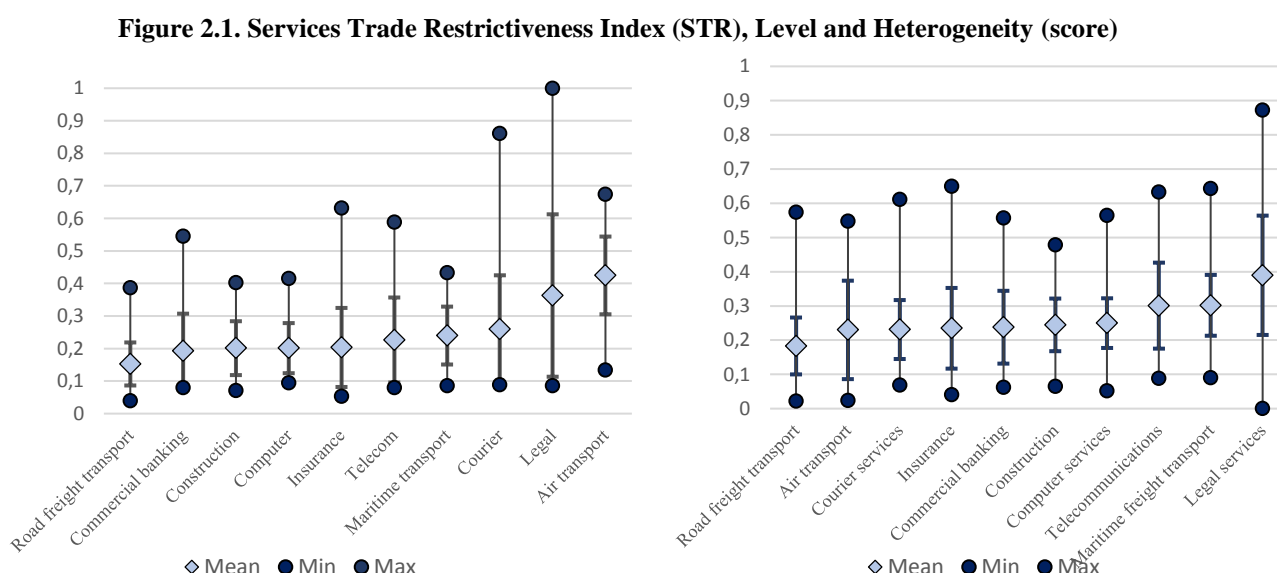
<sup>2</sup> Appendix B provides additional information on the WIOD and TSD as well as an overview of country and sector coverage.

## **2.2. Regulations of services and regional trade integration**

Service providers frequently face non-tariff trade barriers (NTB) in the form of country-specific regulations which tend to vary across countries (Nordås et al., 2016). An NTB is defined as any government policy that favours local over foreign producers, or which restricts or raise the cost of access to a domestic market by foreigners (Copeland and Mattoo, 2008). Common types of NTBs are policies that are restrictive in terms of either quantity or price regulations, existence of state monopolies that hinders market access, qualification or certification requirements, and operational restrictions for foreign service providers (Kox and Lejour, 2005). These policies can be roughly divided into categories of *market access* and *discrimination*. The first consist of regulations that apply to entry, establishment and operations of a firm that may hinder market access. The rationale is that regulations, given that they are higher or different from the domestic market, generates additional trade costs associated with exporting. Additionally, if such regulations are heterogeneous across countries, a firm must pay a similar amount of costs for every new market they enter. While *discrimination* occurs if a foreign firm faces other regulations than the domestic provider, noteworthy, it also takes place if the cost of confirming to such regulations is much higher for the foreign than the domestic provider.

The OECD has recently developed two indices that quantify the level of regulatory restrictiveness as well as the degree of regulatory heterogeneity in international trade in services, known as the Services Trade Restrictiveness Index (STRI) and the STRI Regulatory Heterogeneity (hereafter *STRI Level* and *STRI Heterogeneity*). The indices are available at a country and sector level, and capture restrictions across five policy categories: restrictions on foreign entry, restrictions on the movement of people, other discriminatory measures, barriers to competition and regulatory transparency (Geloso et al., 2015). The STRI Level ranges from 0 to 1, where 0 indicates that a sector in a country is completely open while 1 indicates that it is completely closed. For the purpose of interpretation, a STRI Level above 0.1 can be regarded as significant (OECD, 2014). The left hand side of Figure 2.1 demonstrates that there is variety

in the STRI Level across countries and sectors. Legal services and air transport are on average the most restrictive sectors, while road freight transport and commercial banking are the least restrictive. The other sectors ranges between 0.2 and 0.26. Thus, on average, the level of restrictiveness is quite high in most sectors although the standard deviations reveal large variety in most sectors. The STRI heterogeneity is bilateral and reflects the weighted share of policy measures for which two countries have different regulations in a sector (Nordås, 2016). The right hand side of Figure 2.1 provides the average STRI Heterogeneity for each sector. It is highest (above 0.3) in legal services, telecommunications and maritime freight transport, whilst road freight transport has the lowest value.<sup>3</sup>



Preferential trade agreements (PTAs) on services have become a central feature of bilateral and regional trade agreements being negotiated outside the multilateral trade system (Roy, 2016). More than 100 PTAs including services have been notified under the GATS from 2000 to 2014, in contrast, only six agreements were notified as of 2000 (Marchetti and Roy, 2014). The large increase reflects that bilateral and plurilateral trade policy strategies have emerged as a result of slow progress in the negotiations of the Doha Round (Baldwin, 2011; 2012). Applied policy in service sectors is more liberal than the legally bounded measures in the

<sup>3</sup> Figure 2.1 is based on the countries in the data sample used in section 4, which is mostly OECD countries. Appendix C provides corresponding tables for the STRI indices. Note that there are two STRI Heterogeneity indices that are based on either answers or scores.

GATS commitments established under the Uruguay Round (denoted *GATS commitments*), causing a gap between applied and bounded policies. The Doha Round offers (denoted *GATS+ offers*) would only reduce some of this gap, and therefore they do not offer “real liberalisation” but rather a “locking in” of applied policies. In contrast, commitments within PTAs established during 2000-14 offer “real liberalisation” through broader sector coverage and a higher level of commitments (Roy, Marchetti and Lim, 2007; Roy, 2016). These dynamics apply to measures which affects both cross-border trade in services as well as commercial presence. The trade effect of applied policy measures on trade in services is linked to the mode of supply, and whether these are complements or substitutes, and to each sector’s underlying market structure (Francois et al., 2010). If a policy measure is a binding barrier to trade or redundant in practice, that is, if the exporter chooses the other mode of supply, is important to have in mind when analysing the impact of regulatory trade barriers on international trade in services.

### **3.1. The concepts of global value chains and value-added**

A global value chain (GVC) can be thought of as a system of value-added sources and destinations. Koopman et al. (2014) describe it as a chain of various stages of production that each involves a producer that buys inputs and then adds further value, which is contained in the cost of the next stage of production. At each stage, this value-added is equal to the value paid to the production factor in the exporting country. Thus, by measuring trade in value-added terms, we identify the value that is added by industries and countries in producing goods and services, and then allocate this value-added to either domestic or foreign sources of industries.

Measurement of trade in value-added terms rather than in gross terms may be more appropriate in a world where trade and production increasingly take place within GVCs (Solaz, 2016; Johnson, 2014). First of all, fragmentation implies that production of a single good takes place across several countries and inputs cross borders many times. Since official trade statistics use gross terms, which include final products as well as domestic and foreign intermediate



inputs, they indeed “double-count” the value of intermediate products that cross international borders more than once (Koopman et al., 2014). Moreover, gross exports of goods are to a high extent embodied in inputs sourced from abroad as well as inputs which are initially produced at home, then processed abroad and ultimately returned home to be used in the production of a final goods. As a result, gross exports tend to overstate the share of domestic value-added in exports and does not properly reflect the real contribution of a given export to the economy (Johnson, 2014). Secondly, trade in gross terms does not identify indirect sectors that add value to a product exported for final consumption, which particularly applies to the service sectors (Francois et al., 2015). In contrast, by tracing value-added across countries and sectors, the trade in value-added concept better reflects that countries’ exports increasingly rely on intermediate inputs of goods and services sourced from markets both at home and abroad (Francois et al., 2008; 2015).

Participation in GVCs is typically evaluated through either forward or backward participation. The former measures the share of domestic value-added (i.e. domestic inputs) used in production of exports abroad, whilst the latter is the share of foreign value-added (i.e. imported inputs) embodied in exports of the source country (Kowalski et al., 2015). Hummels, Ishii and Yi (2001) define backward participation as *vertical specialization* and provide the first indicator’s mathematical formula grounded in an input-output framework. The authors further propose a country’s share of domestic inputs used in the production of foreign countries’ exports as a measure of forward participation. Koopman et al. (2014) develop the framework in Hummels et al. (2001) by integrating the literature on vertical specialisation and the literature on value-added in a complete mathematical framework that decomposes gross exports with the purpose of tracing domestic and foreign value-added, quantifying double-counted elements, as well as providing mathematical definitions for forward and backward vertical specialisation.

### 3.2. Participation of service sectors in global value chains

The contribution made by services in GVCs turns out to be much more apparent when using the trade in value-added concept (Miroudot, 2016). As pointed out by Johnson (2014) and Francois, Manchin and Tomberger (2015), trade in services is relatively larger whilst trade in manufactured goods is relatively smaller when using the value-added concept instead of gross exports. This follows from the fact that gross manufacturing exports include value-added from the service sectors as manufacturing firms buy services as inputs, whereas value-added that originates in services is reallocated to the service sectors itself rather than the manufacturing industry's exports with the value-added trade measurement. Double counted intermediates is another explanatory determinant because the same value-added generated in the manufacturing sectors tend to be exported several times due to vertical chains of production (Johnson, 2014; Koopman et al., 2014).

Sectors of services and goods participate differently in GVCs. For instance, the degree of backward vertical specialisation tends to be higher for manufactured goods than for services (Miroudot, 2016; Timmer et al., 2016). In contrast, service sectors engage relatively more in forward vertical specialisation since they represent mainly activities in the beginning of value chains. In a global perspective, Francois et al. (2015) find that *direct* and *indirect* value-added exports of services through forward linkages were considerably more important than gross exports of services from 1992 to 2011. In particular, the authors emphasize that *indirect* value-added exports of services alone exceed gross exports of services. Indirect value-added exports reflect trade in intermediate services which are embodied in a given country's exports of final products, thus, its growth implies that services role as inputs in the structure of global production and trade has increased. Indeed, such "servicification" of production is an important feature of GVCs (Francois et al., 2015; Miroudot, 2016). For instance, financial services, distribution, transport and technical engineering services are essential to link trade and production processes within manufacturing production that is located in diverse geographical

locations. Recent evidence also suggest that value chains of services are expanding and that the use of foreign inputs has grown, particularly for financial services and business services (De Backer and Miroudot, 2013).

### 3.3. Methodology: Tracing value-added in the input-output framework

The methodology for this study follows the framework in Koopman et al. (2014) and Timmer et al. (2013). The main elements are presented here while Appendix D gives a complete overview. There are  $G$  countries and  $N$  sectors, each sector in a country (i.e. country-sector) produces one good or service that are absorbed at home or abroad either as a final product or an intermediate input in production. Domestic production factors and intermediate inputs are used to produce output in each sector, whereas the latter is sourced from either domestic or foreign suppliers. We assume market clearing in the model, that is, the gross output of a product in each country-sector equals the sum of products absorbed in final consumption and intermediate inputs in production. The market clearing for each of the  $GN$  products is expressed in block matrix notation as (3.1)  $X = AX + Y$ , where  $X$  is a  $GN \times 1$  vector of production that consists of output levels in each country-sector, and  $Y$  is a  $GN \times 1$  vector that gives world *final* demand for output in each country-sector.  $A$  denotes the  $GN \times GN$  global intermediate input coefficient matrix where a representative element  $a_{sr}(i, j) = M_{sr}(i, j)/X_r(j)$  reflects sector  $i$ 's output (in country  $s$ ) used as intermediate input in sector  $j$ 's production (in country  $r$ ) as a share of total output in the latter sector (in country  $r$ ). The key step is to rearrange condition (3.1) so that we obtain the fundamental input-output identity: (3.2)  $X = (I - A)^{-1}Y = BY$ . The  $B$  denotes the  $GN \times GN$  Leontief inverse matrix (Leontief, 1936), where each representative element gives total production value (both direct and indirect) of any sector  $s$  required for production of one unit of final output in any sector  $r$  (Timmer et al., 2013).

We further define  $\hat{V}$  as a  $GN \times GN$  diagonal matrix with value-added coefficients along the diagonal and off-diagonal elements equal to zero, and obtain the  $GN \times GN$  *value-added production matrix* ( $\hat{V}BY$ ) by multiplying  $\hat{V}$  with the right hand side of equation (3.2). The

resulting matrix provides estimates of domestic and foreign country-sector sources of direct and indirect value-added used in each country-sector's production of final goods consumed at home or abroad. In short, off-diagonal column elements describe value-added production absorbed by foreign demand and thus represents exports of value-added.

Value added exports is defined in Johnson and Noguera (2012) as those exports produced by domestic value-added in the country of origin and absorbed in the country of destination. Thus, the concept excludes value-added that is initially exported by the home country and ultimately returned home for consumption after being processed abroad. Koopman et al. (2014) define total value-added exports from country  $s$  to the world as (3.3), which they further decompose according to where and how the value-added exports are absorbed in equation (3.4). Note that (3.3) and (3.4) are grounded in forward industrial linkages.

$$(3.3) \quad VT_{s*} = \sum_{r \neq s}^G V X_{sr} = V_s \sum_{r \neq s}^G \sum_{g=1}^G B_{sg} Y_{gr} \quad (3.4) \quad VT_{s*} = V_s \sum_{r \neq s}^G B_{ss} Y_{sr} + V_s \sum_{r \neq s}^G B_{sr} Y_{rr} + V_s \sum_{r \neq s}^G \sum_{t \neq s, r}^G B_{sr} Y_{rt}$$

$$(3.5) \quad E_{s*} = \sum_{r \neq s}^G E_{sr} \sum_{r \neq s}^G (A_{sr} X_r + Y_{sr})$$

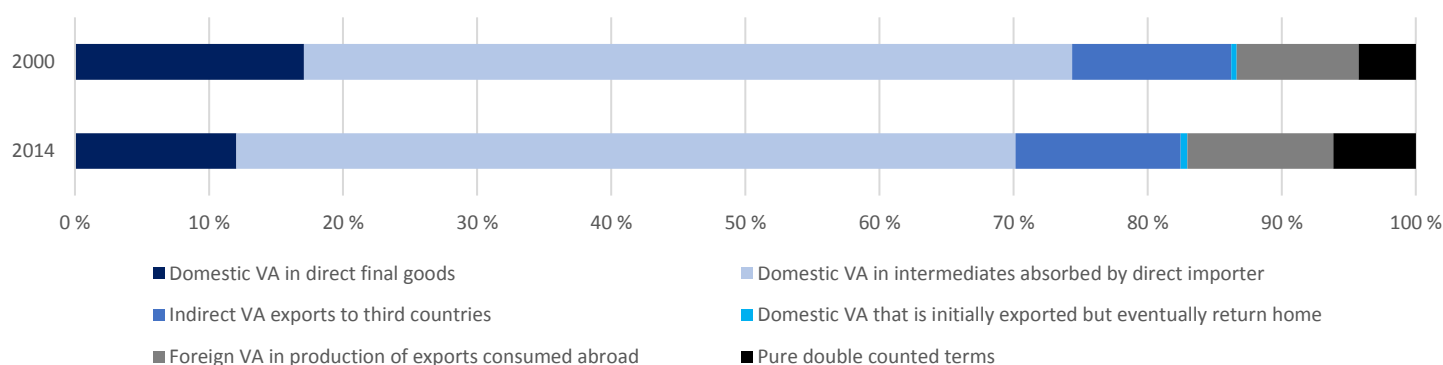
Equation (3.4) decomposes value-added exports in terms of final demand in all countries. The first term reflects value-added in exports of final goods from country  $s$  that are ultimately absorbed abroad. The second term gives value-added in intermediate exports used by the direct importer to produce final goods consumed in the importer's market, whereas the third term is value-added in intermediate exports used by the direct importer to produce final goods shipped to third countries. The first term is denoted *direct value-added* exports whilst the two latter reflect *indirect value-added* exports. Equation (3.5) reflects a country's gross exports to the world and includes exports of intermediates and final goods. Koopman et al. (2014) further decompose gross exports into nine components of foreign and domestic sources of value-added as well as double-counted trade, and provide mathematical definitions of backward and forward vertical specialisation (VS and VS1). The VS measures the share of foreign inputs in gross exports of a country or a country-sector, while the VS1 is the share of intermediates used as

inputs by foreign countries to produce final exports to third countries, in a given country's gross exports.

### 3.4. Results for the Norwegian economy

The Norwegian economy has a comparatively high share of domestic value-added in its gross exports, which amounted to 86.2 percent in 2014, and thus exceeding the OECD average of 70.3 percent.<sup>4</sup> The dominance of domestic value-added is common for countries rich on natural resources since they specialize in exports of commodities, which are upstream activities towards the beginning of value chains (OECD, 2015b). For instance, the Mineral and quarrying sector accounted for 47.9 percent of Norway's gross exports in 2014. However, services have an increasing role in the economy with Transport and storage (including Water transport), Wholesale and retail trade and Financial and insurance services being the most exported sectors in terms of value-added in 2014. Noteworthy, results suggest that exports of services exceed exports of manufactured goods when measured in value-added terms. The domestic content also tends to be higher for service sectors than for manufactured goods. Fishing and agriculture is another important export sector for Norway, and the results suggest that since 2007 gross exports grew relatively more than value-added exports. The latter may be explained by a higher use of foreign intermediate inputs. Note that all figures in section 3.5 are based on the author's calculations using the WIOD 2016.<sup>5</sup>

**Figure 3.1. Shares of value-added (VA) by origin and double-counted components in gross exports**



<sup>4</sup> The OECD average is from 2011 and obtained from the OECD-WTO Trade in Services Database.

<sup>5</sup> Appendix E provides corresponding tables for all figures in section 3.

Following the decomposition framework in Koopman et al. (2014), Figure 3.1 demonstrates the percentage shares of domestic and foreign value-added as well as double-counted components in Norway's gross exports, the latter refers to all primary, manufacturing and service sectors. The share of domestic value-added in total gross exports fell from 86.6 to 83 percent from 2000 to 2014, primarily due to a decrease in domestic value-added in products directly consumed as *final* goods by the importer (from 17.1 to 12 %). The three first components of domestic value-added in Figure 3.1 sum to value-added exports, which decreased from 86.2 to 82.5 percentage shares of gross exports from 2000 to 2014. The foreign value-added in Norway's production of exports consumed abroad grew with only one percentage point (from 9.1 to 10.1 %), which is explained by a higher share of foreign value in exports of intermediates, although it was balanced out by a fall in foreign value-added in exports of final products. Double counted components rose from 4.3 to 6.2 percent mainly due to an increase in double-counted foreign intermediates. In sum, the decomposition of gross exports reveals that Norway has a substantially higher share of domestic rather than foreign value-added in production and exports, although there has been a fall in domestic value and rise in foreign value embodied in gross exports.

The decomposition of gross exports reflects that Norway's participation in global production and trade primarily occurs through forward industrial linkages. Indeed, the share of domestically produced inputs used by importing countries to produce exports to third countries (VS1) grew from 37.2 to 45.3 percent from 2000 to 2014. Participation through backward industrial linkages (VS) also became stronger as the share of foreign inputs in gross exports grew from 13.1 to 16.8 percent in the same period. The sum of VS and VS1 gives the total GVC participation index, which reveals that Norway's integration into GVCs grew from 50.3 to 62.1 percent in the given period.

Important results appear when aggregating the economy into three broad sectors denoted *primary*, *service* and *manufacturing*. The primary sector includes trade in goods from primary sectors such as agriculture, forestry and fishing, the service sector covers both construction, commercial, cultural, transport, storage and public services, and the manufacturing sector includes traded goods from industrial production.<sup>6</sup> We have excluded oil related activity in the following figures (i.e., the Mineral and quarrying sector) in order to focus on the other economic activities in the Norwegian economy. Figure 3.2 demonstrates the development in gross and value-added exports in the aggregated sectors from 2000 to 2014, and two notable results appear. First of all, value-added exports are above gross exports of services during the whole period. The opposite is true for the manufacturing sector. Secondly, trade in services exceeds manufacturing trade when measured in value-added terms. The fall in manufacturing exports when using value-added rather than gross term measurement reflects that the first method reallocates value-added originating from services into the service sectors itself rather than as output in the manufacturing sectors. The large difference between exports in gross and value-added terms does not apply to the primary sector, although, gross exports have exceeded value-added exports since 2008. Note that exports in the primary sector would rise substantially if the Mining and quarrying sector were included.<sup>7</sup> Finally, foreign value-added content in gross exports grew for both the primary, manufacturing and service sector from 2000 to 2014.<sup>8</sup>

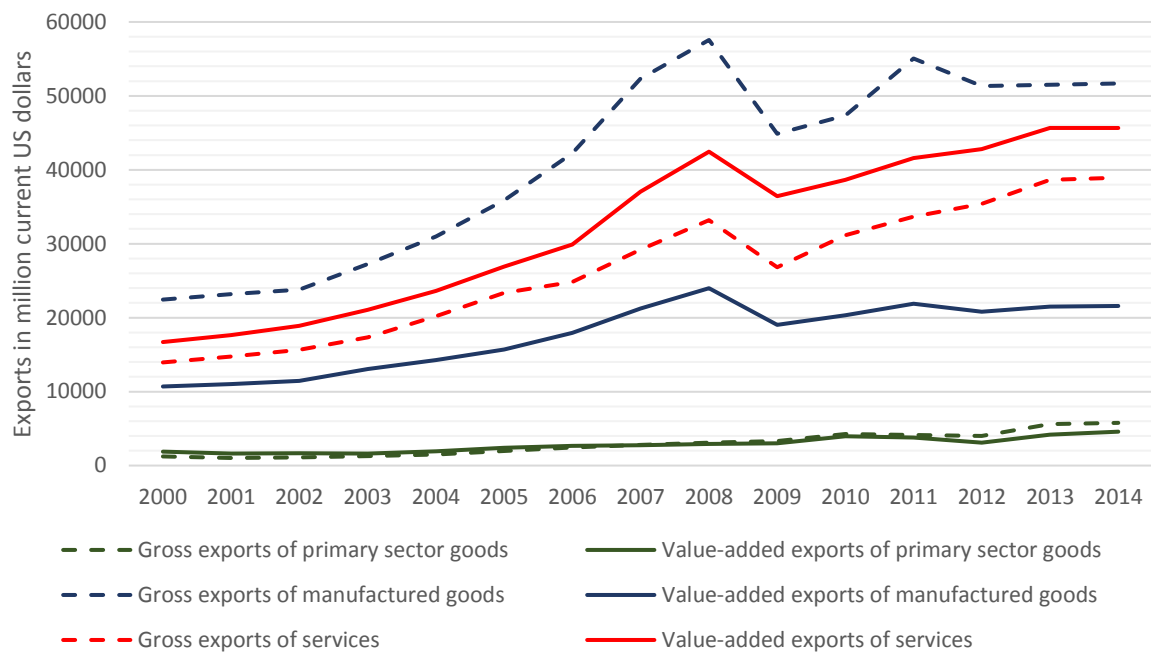
---

<sup>6</sup> The aggregated sectors *primary*, *manufacturing* and *service* are defined according to ISIC Rev. 4 Divisions 1-3, 5-23, 27-56, respectively. Note that Mining and quarrying (Division 4) is excluded in the primary sector.

<sup>7</sup> See Figure E.1 in Appendix E for gross and value-added trade of Mineral and quarrying.

<sup>8</sup> Primary from 12.8 to 17 % (4.2 p.p.), manufacturing from 25.9 to 28.2 % (2.3 p.p.) and services from 20 to 22.9 % (2.9 p.p.).

**Figure 3.2. Value-added and gross exports of goods and services**

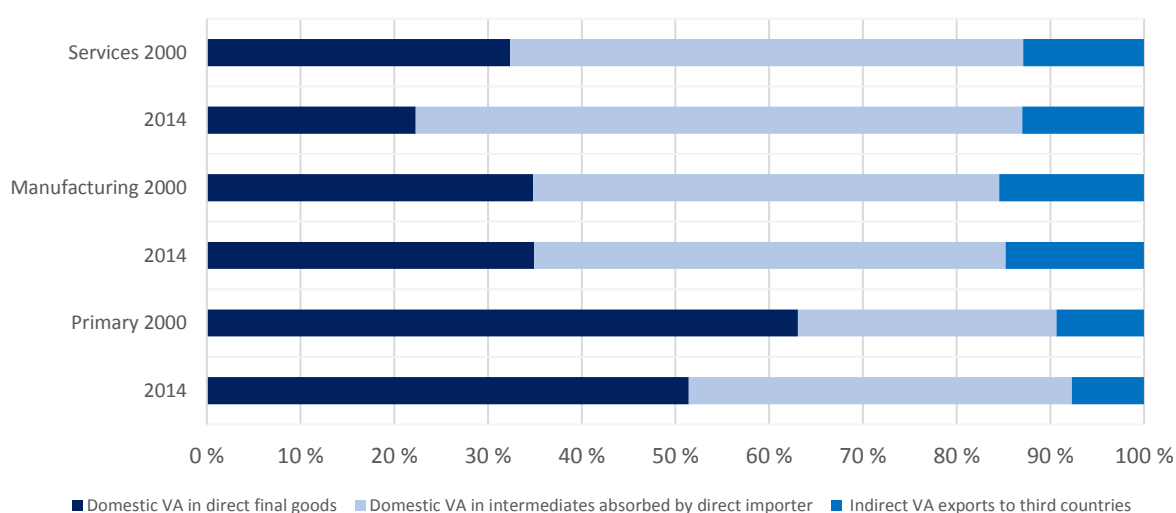


We observe a fall in Norway's trade in 2008-2009, which picked up in 2009-2011, and stagnated for manufactured goods since 2011. Similar trends apply for total world trade during the given periods, and literature documents that low economic activity is the primary determinant for the trade collapse and stagnation (IMF, 2016), whereas Timmer et al. (2016) also point towards ongoing shifts in linkages between trade and GDP growth. The authors exploit the WIOD 2016 to construct a measure of fragmentation that traces the import needed in all stages of production of a final good or service. Interestingly, their analysis suggests that imports of goods and services as percentage of world GDP fell sharply in 2008-2009 while it stagnated in 2011-2014. They further argue that two principal forces drove the growth in world trade until the collapse in 2008, namely, high demand for trade-intensive products such as manufactured goods and continuous international production fragmentation. Timmer et al. (2016) further point out that GVC trade quickly rebounded after the crisis in 2008, in particular since global demand shifted towards products with low import intensity such as services in the 2008-2011 period. Interestingly, from Figure 3.2 we observe that these trends are reflected in Norway's trade. For instance, trade in services grew relatively more than trade in manufactured



goods after 2008, and the stagnation since 2011 is relatively more apparent for the latter. We evaluate how forward integration into GVCs have changed by examining changes in the composition of value-added exports. Figure 3.3 decomposes value-added exports into three components of domestic value-added as in equation (3.4), in which each component reflects percentage shares of total value-added exports in either the primary, manufacturing or service sector. We observe that domestic value-added in *intermediate* exports used directly by the importer to produce final products are the largest components for both manufactured goods and services (50.3 and 64.7 % in 2014). However, the share grew by 10 percentage points from 2000 to 2014 for services whilst it remained almost unchanged for manufactured goods. The increasing importance of intermediate rather than direct exports of services is in line with the findings in Francois et al. (2015), which point toward an increased role of services as inputs in global production and trade. Finally, the primary sector experienced a similar growth as services in terms of exports of intermediates from 2000 to 2014 (+13.3 p.p.), but domestic value-added remained the biggest component.

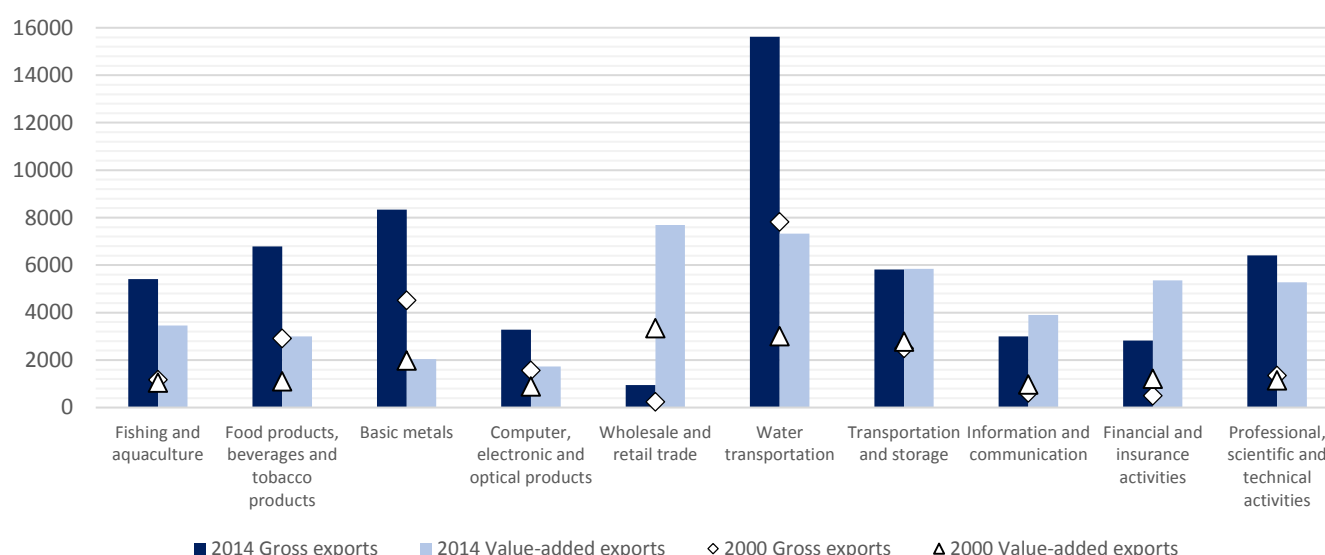
**Figure 3.3. Decomposition of value-added (VA) exports of goods and services**



Sectors that are central for Norway's exports to the world are analyzed in the following, whereas services are emphasized. The results suggest that the general trends for the aggregated primary, manufacturing and service sectors described earlier also apply at the disaggregated

sector level. First, the value-added exports are higher than gross exports in most service sectors whilst the opposite result applies to manufacturing sectors. Second, the domestic content is high in all sectors but tend to be higher for service sectors. However, there is heterogeneity across sectors. For instance, gross and value-added exports are almost equal in the Transportation and storage sector, whilst Water transport exports are substantially higher if measured in gross terms rather than value-added terms. In contrast, the Wholesale and retail trade sector's exports increase substantially if measured in value-added rather than gross terms. These findings are reflected in Figure 3.4, which illustrates gross and value-added exports by sector in 2000 and 2014.

**Figure 3.4. Gross and value-added exports by sector**

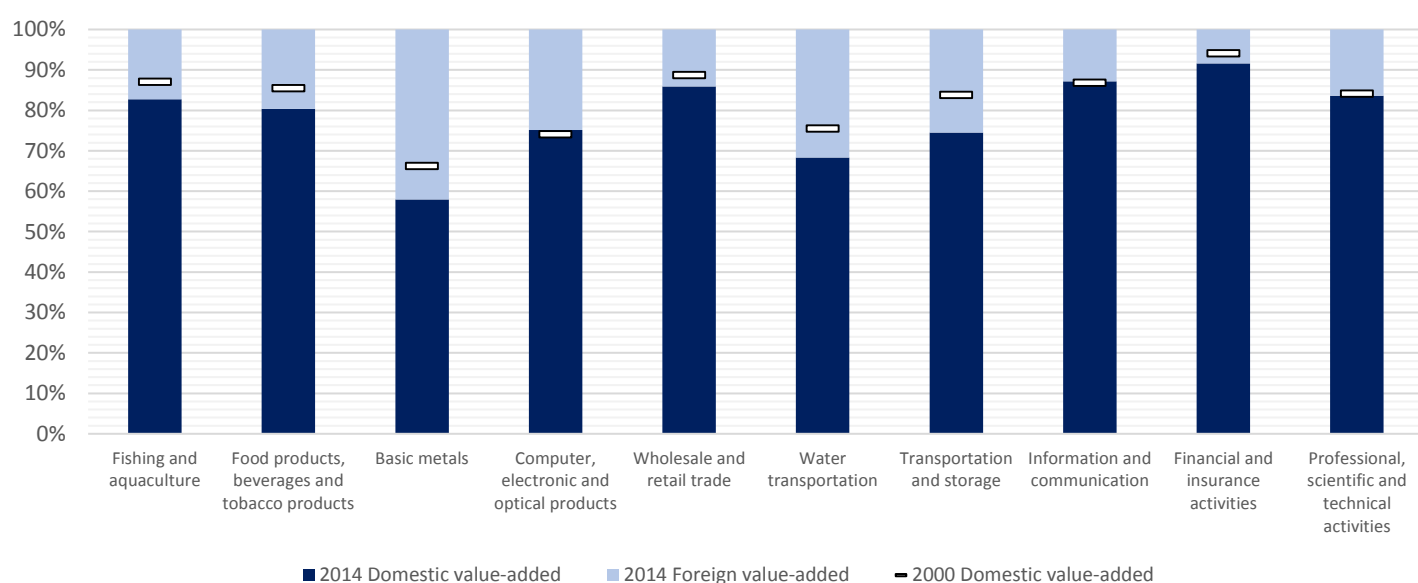


*Exports in million current US dollars.*

Figure 3.5 illustrates domestic and foreign value-added sources in production in 2000 and 2014, as shares of gross exports by sector. The foreign value-added share is equal to the vertical specialization measure (VS), and illustrate how the sectors participate in GVCs through backward linkages. In general, there is not a high content of foreign inputs in the sectors' gross exports. Indeed, the high share of domestic value in all sectors imply that they primarily participate in activities towards the beginning of value chains. The share of foreign inputs did increase slightly for all sectors except Computer, electronic and optical products as well as

Information and communication. The Basic metals sector stands out as the industry with the highest content of foreign value-added. Of particular interest, Transportation and storage in addition to Water transport contain relatively large and increasing shares of foreign value-added compared to the other services sectors. Financial and insurance activities contain the largest share of domestic value-added of all sectors, which hardly changed.

**Figure 3.5. Domestic and foreign value-added in production**

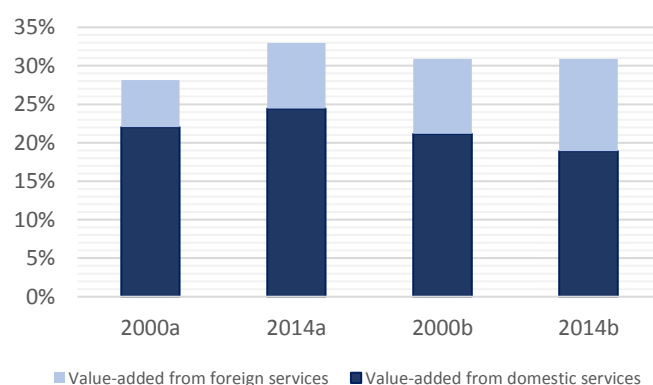


We finally assess what role domestic and foreign services have in Norway's gross exports. Figure 3.6 demonstrates value-added from domestic and foreign services embodied in total gross exports of goods and services on the left, and in the manufacturing sector as defined earlier on the right hand side. Note that the measurement behind is useful to observe the role of services as inputs in value chains, but do not properly reflect the role of in-house services in manufacturing firms because information in the WIOD is based on industries and not tasks (Miroudot, 2016). Total value-added contribution from services in gross exports of goods and services rose from 28.1 to 33 percent from 2000 to 2014, with increases around 2 p.p. for both foreign and domestic shares. If we look at services embodied in manufacturing exports, both shares become relatively higher, and in 2014, the respective shares of domestic and foreign value-added amounted to 18.9 and 12 percent. Wholesale and retail trade, Transportation and

storage, and Financial and insurance activities were the largest domestic sectors. Regarding foreign sectors, Professional, scientific and technical activities substitutes the latter while the two first sectors remain the same. We also note that the domestic and foreign shares in manufacturing exports have, respectively, decreased and increased slightly.

Miroudot (2016) performs a similar exercise using the OECD Trade in Value Added Database (TiVA) in which he distinguishes the direct and indirect value-added content from domestic and foreign services in a given country's *total* gross exports. The author points out that the directly exported domestic content is relatively low for Norway compared to “service economies” such as Netherland and Luxembourg, a result which reflects Norway's specialization in exports of commodities. However, the indirectly exported domestic content is relatively higher for Norway. The sum of the direct and indirect value-added from domestic services expressed as shares of gross exports amounted to 35 percent in 2011, whilst the OECD average was 54.3 percent (OECD-WTO, 2015b). Thus, the average OECD economy has experienced deeper “servicification of value chains”.

**Figure 3.6. Domestic and foreign value-added shares in gross exports of (a) total goods and services and (b) manufactured goods**



#### 4.1. Estimating the effects of regulatory trade barriers and trade policy on trade in services

Literature that combines the gravity framework and international trade in services trade is relatively new and limited. So far, applications have found that the standard trade cost variables such as distance, sharing an international border and having a common language apply to trade flows of services (Walsh, 2008). Recent literature has used the Anderson and van Wincoop gravity model to examine to what extent the level of restrictiveness in services regulations and regulatory heterogeneity across countries impedes international services trade. For instance,

Marel et al. (2013) find that regulatory restrictiveness lowers cross-border trade in services, although there appear to be heterogeneity across sectors with respect to the strength and nature of the link. Furthermore, they find a significant and positive, but surprisingly small effect of two countries being members of the same regional trade agreement (RTA). Nordås et al. (2016) use the OECD STRI indices, and find that both the level and heterogeneity of regulations affect trade negatively.

The main elements of the structural gravity system in Anderson et al. (2003) are presented in the following while a complete overview is provided in Appendix F. The framework is grounded in some essential assumptions. Goods are differentiated by origin, implying that each country-sector is specialised in the production of one good, the supply of goods is fixed, and there is market clearing in the model. Finally, consumers have homothetic preferences over all goods that are identical across countries, and preferences are approximated by a constant elasticity of substitution (CES) utility function (Yotov et al., 2016). Anderson et al. (2003) presents the structural gravity system of trade in equations (4.1) - (4.3).

$$(4.1) \quad x_{sr,t} = \frac{y_{s,t}y_{r,t}}{y_{w,t}} \left( \frac{t_{sr,t}}{\pi_{s,t}P_{r,t}} \right)^{1-\sigma}$$

$$(4.2) \quad \pi_{s,t}^{1-\sigma} = \sum_r \left( \frac{t_{sr,t}}{P_{r,t}} \right)^{1-\sigma} \frac{y_{r,t}}{y_{w,t}}$$

$$(4.3) \quad P_{r,t}^{1-\sigma} = \sum_s \left( \frac{t_{sr,t}}{\pi_{s,t}} \right)^{1-\sigma} \frac{y_{s,t}}{y_{w,t}}$$

Equation (4.1) gives the structural gravity equation where  $x_{sr,t}$  denotes trade flows from exporter  $s$  to exporter  $r$  in year  $t$ ;  $y_{s,t}$  is the value of total production in exporter  $s$ ;  $y_{r,t}$  is the total expenditure in importer  $r$ ; and  $y_{w,t}$  is the value of world output. The elasticity of substitution between goods from all countries or the *trade elasticity* is equal to  $> 0$ , and  $t_{sr,t}$  is bilateral trade costs between  $s$  and  $r$ . The outward and inward multilateral resistance terms are  $\pi_{s,t}$  and  $P_{r,t}$  in equation (4.2) and (4.3), respectively, which represents the groundbreaking contribution by Anderson et al. (2003) to the gravity literature. Indeed, the authors demonstrated that controlling for *relative* trade costs and not only *absolute* trade costs is critical for obtaining a well-specified gravity model. In particular, by adding the multilateral resistance terms, their

structural gravity system takes into account that the propensity of country  $r$  to import from country  $s$  is determined by country  $r$ 's trade costs toward country  $s$  relative to the *both* its overall “resistance” to imports (weighted average trade costs) and to the average “resistance” facing exporters in country  $s$ .

Turning to the empirical methods for estimating the gravity equation, the traditional procedure has been to take the natural log of equation (4.1), add importer and exporter fixed effects, and estimate the parameters using ordinary least squares (OLS) since the contribution by Anderson et al. (2003). The inclusion of importer and exporter fixed effects takes into account, respectively, the inward and outward multilateral resistance terms. Still, there are two essential limitations related to the traditional estimation approach: it suffers from potential heteroscedasticity and presence of zero trade flows in trade data. Silva and Tenreyro (2006) show that the Poisson Pseudo-Maximum-Likelihood (PPML) estimation generates consistent estimates of the gravity equation and is robust to patterns of heteroscedasticity. Moreover, since the dependent variable is in level rather than in logs, it is a natural way to deal with zero values in the dependent variable (Silva et al. 2003). Indeed, zero trade flows are important to include because they could indicate high trade barriers. The literature further advocates the use of exporter and importer fixed effect in the PPML estimations, which should be time-varying in a panel (e.g. Olivero and Yotov, 2012; Feenstra, 2015).

Endogeneity of trade policy is another challenge in obtaining reliable estimates of the effects of trade policy in the gravity model (Yotov et al., 2016). In particular, it may occur when including dummies that are equal to unity if two bilateral trade partners are members of the same trade agreement. The rationale being that, all else equal, countries that trade a lot with each other in the outset are more likely to enter into a trade agreement. This would mean that there is reverse causality. There have been attempts to deal with the issue through an instrumental variable approach, but there is lack of appropriate instruments available (Yotov et

al., 2016; Baier and Bergstrand, 2007). Baier et al. (2007) and Yotov et al. (2016) propose to use country-pair fixed effects to account for unobservable linkages between endogenous free trade agreements and the error terms.<sup>9</sup>

#### 4.2. Empirical specification

Specification (4.4) gives the baseline regression which is pooled over sectors.<sup>10</sup> The dependent variable is cross-border trade of services from country  $s$  to country  $r$  in sector  $k$  in year  $t$ , it is measured in current US dollars and based on the 2007-2009 period in the TSD. Note that we use the latest years with complete data available for OECD countries in the TSD to match trade data and policy variables as closely as possible with respect to time. The analysis is limited to 42 countries and 9 sectors due to the limited coverage of the STRI indices.<sup>11</sup> We use the PPML estimator as advised in the literature (Silva et al., 2006, Yotov et al., 2016).

$$(4.4) \quad X_{srkt} = \exp[\beta_0 + \beta_1 STRIhet_{srkt} + \beta_2 STRIhet_{srkt} * STRI_{skt} + \beta_3 STRIhet_{srkt} * STRI_{rkt} + RTA_{sr} + \beta_4 z_{sr} + s_k + \pi_{st} + P_{rt} + d_t + \varepsilon_{srkt}]$$

The explanatory variables of main interest are the bilateral STRI heterogeneity index, the interaction terms between the heterogeneity index and either the exporter or the importer STRI Level. Note that the estimation approach follows Nordås et al. (2016) closely. The interaction terms are used to take into account how heterogeneous regulations across countries are affected by the *level* of restrictiveness in each country. Since the STRI Level is country specific, its *direct* effect on trade flows cannot be estimated when including a full set of exporter and importer fixed effects due to perfect collinearity. However, the *indirect* effect can be estimated by interacting each country pair's regulatory heterogeneity index with the subsequent STRI level of the exporter or importer. Hence, interaction terms are included in order to condition the effect of regulatory heterogeneity on the *level* of restrictiveness. The RTA dummy is obtained from De Sousa (2012) and is equal to one if a country pair share a regional trade agreement that contains a service component.  $z$  is a vector of bilateral gravity variables for each country pair

<sup>9</sup> We do not apply country-pair fixed effects since it is not possible when using the PPML Stata command developed by Silva et al. (2006)

<sup>10</sup> We also performed sector specific regressions of specification (4.4) and Appendix G provides the results.

<sup>11</sup> Summary tables of the data used are provided in Appendix G.

obtained from the CEPII gravity dataset (Head and Mayer, 2014). *Colony* equals one if a country pair share colonial ties, *language* equals one if the pair share the same “most” spoken language; and *common legal origin* equals one if they share legal origin. The logarithm of *distance* and *contiguity* are proxies for distance, which together amounts roughly to a non-linear variable for distance. The first is the logarithm of distance (in km) between each country pair’s most populated cities, and the latter equals’ one if they share an international border. The additional variables represent sector fixed effects, time-varying exporter and importer fixed effects, time dummies and the error term.

#### **4.3. Results from the gravity analysis**

Table 4.1 provides results for the pooled regressions. Column (1) represents the baseline regression, column (2) and (3) include the score and answer based indices, respectively, whilst column (5) and (6) also include interaction terms. The estimates for distance, common legal origin and colony are statistically significant at a 1 percent level, in which the first has a negative impact on trade flows and the others have a positive impact. The standard value for the distance estimate in gravity regressions of trade in goods is -1 (Disdier and Head, 2008; Head and Mayer, 2014), which implies that a 10 percent increase in distance lowers trade flows with 10 percent (Yotov et al., 2016). In contrast, the distance estimates are less than half that value when examining trade in services in pooled gravity regressions in Nordås et al. (2016) and Marel et al. (2013), results that also apply to the distance estimates in Table 4.1 of this study. Although, the estimates approach -1 for some sectors when running sector specific regressions in Nordås et al. (2013) and Marel et al. (2013). Whether a country pair shares a common border or language is positive but insignificant in all specifications, whilst it has a positive and significance level of 10 percent if the countries have been or are part of the same country. The estimate for the language dummy became highly significant when we excluded the dummy for legal origin, suggesting that the latter captures the effect of having a common language.



**Table 4.1. PPML Pooled Regressions, STRI Heterogeneity and STRI Level**

	(1)	(2)	(3)	(4)	(5)
Log distance	-0.383*** (0.0670)	-0.377*** (0.0679)	-0.373*** (0.0679)	-0.371*** (0.0684)	-0.366*** (0.0676)
Contiguity	0.0378 (0.112)	0.0448 (0.112)	0.0296 (0.112)	0.0603 (0.112)	0.0249 (0.113)
Common language	0.0982 (0.119)	0.0942 (0.119)	0.103 (0.119)	0.0859 (0.118)	0.107 (0.119)
Common legal origin	0.340*** (0.0705)	0.336*** (0.0702)	0.332*** (0.0702)	0.323*** (0.0702)	0.329*** (0.0702)
Colonial history	0.372*** (0.0882)	0.362*** (0.0887)	0.356*** (0.0890)	0.339*** (0.0883)	0.344*** (0.0884)
Same country	0.318* (0.175)	0.322* (0.175)	0.323* (0.176)	0.329* (0.174)	0.327* (0.176)
RTA	0.808*** (0.151)	0.781*** (0.152)	0.789*** (0.152)	0.769*** (0.155)	0.788*** (0.155)
Heterogeneity score		-0.513* (0.306)		-2.336*** (0.681)	
Heterogeneity answer			-1.086*** (0.366)		-2.171*** (0.781)
Heterogeneity score × STRI exporter				3.300*** (0.743)	
Heterogeneity score × STRI importer				1.208 (0.825)	
Heterogeneity answer × STRI exporter					2.857*** (0.868)
Heterogeneity answer × STRI importer					-0.285 (1.173)
Exporter-year and importer-year FEs	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	38,214	38,214	38,214	38,214	38,214
Pseudo-R <sup>2</sup>	0.439	0.442	0.444	0.448	0.449
(i)	The dependent variable is bilateral exports (in million current US dollars) of trade in services from 2007-2009.				
(ii)	Pooled over 9 sectors: road freight transport, commercial banking, construction, computer, insurance, courier, legal services telecommunications and air transport.				
(iii)	Robust standard errors clustered by country pair in parentheses.				
(iv)	***, ** and * denote significance at 1, 5 and 10 % levels, respectively.				

The estimates of the RTA dummy are positive and significant at a 1 percent level in all specifications. If interpreted causally, bilateral trade flows increase on average by 115.8 and 119.9 percent if a country pair share a RTA in specification (4) and (5), respectively. Nordås et al. (2016) estimates of an intra-EU dummy is around 60-70 percent, whilst the estimate of a RTA dummy in Marel et al. (2013) is 75 percent. Compared to trade in goods, Baier et al. (2007) show that trade increased on average by 114 percent if a RTA entered into force between 1960 and 2000. Noteworthy, the estimates fall considerably and turn insignificant if we also include an intra-EU dummy. Similar results are documented in Nordås et al. (2016) and Marel et al. (2013), which state that a possible explanation is that EU is the most comprehensive integration project when it comes to trade in services. Thus, the EU dummy is likely to drive the RTA dummy. However, we choose to continue with the RTA dummy since my focus is on regional economic integration and the standard errors of the RTA estimates are smaller than for the EU estimates in the pooled regressions. Turning to the policy variables, the results suggest that

higher regulatory heterogeneity lowers cross-border trade in services in general. The score and answer based heterogeneity indices are negative and significant at 1 and 10 percent levels, respectively, when included individually in specification (2) and (3). If interpreted causally, a 0.05 decrease in regulatory heterogeneity increases trade flows with 2.6 and 5.6 percent on average across all sectors, respectively, for the score and answer based indices. Note that the time-varying fixed effects for exporters and importers capture the *direct* effects of the STRI level indices. When adding the interaction terms in specification (4) and (5), the estimates increase in magnitude and remain significant at 1 percent levels, implying increases in trade flows of 12.4 and 11.5 percent, respectively, for the score and answer based indices. However, the interaction terms allow for different marginal effects conditioned on the *level* of regulatory restrictiveness in the exporter and importer countries. The interaction term of the exporter STRI and the heterogeneity index is positive and significant at 1 percent level, revealing existence of variation in the reported averages in specification (2) and (3). The combination of negative estimates of the heterogeneity index and positive for the interaction terms, suggests that regulatory differences have a larger marginal impact on trade flows the lower the level of trade restrictiveness in the exporting country. Nordås et al. (2016) obtain similar results in terms of magnitude and significance, but in contrast to my results, their estimate for the importer STRI and heterogeneity index is significant.

## **5. Conclusion and trade policy implications**

The application of the input-output frameworks provided in Koopman (2014) and Timmer et al. (2013) in section 3 have demonstrated two important results for Norway's trade in goods and services in the 2000-14 period, noting that exports of oil is excluded. Firstly, trade in services was relatively larger than manufactured goods when measured in value added terms. Second, inputs sourced from domestic and foreign sources were, respectively, higher and lower for services as compared to manufactured goods. However, there is heterogeneity across sectors.

For instance, the foreign content was higher for service sectors such as Transport and storage as well as Water transport. The domestic and foreign content of services in both Norway's manufacturing and total gross exports were relatively low compared to the OECD average, reflecting Norway's specialization in commodities. Although, it should be noted that the value added content of domestic and foreign service in manufacturing exports had, respectively, decreased and increased. Results obtained in the empirical analysis in section 4 suggest that heterogeneous regulations across countries negatively affects international trade in services. The pooled regressions across sectors also suggest that heterogeneous regulations affect the bilateral trade to a higher extent the lower the level of restrictiveness in services of the exporter; while regional trade agreements have a positive impact on international trade in services.

Important trade policy implications are implied by the essential role of services in global value chains as well as regulatory trade barriers in service sectors. First of all, growing international fragmentation during the 2000s has made it more difficult to measure the effect of trade policy applied to service and good sectors since gross bilateral trade flows do not properly reflect the value added contribution by a country or a sector (Aichele and Heiland, 2016), which particularly applies to services. Despite this, it is value added that matters for employment and welfare. Secondly, since services' share in world trade increases substantially if measured in value added rather than gross terms, one should improve the trade policy framework for services.

## 6. References

- Aichele, R, and Heiland, I. (2016). Where is the Value Added? Trade Liberalization and Production Networks. *CESifo Working Paper*, No. 6026. Retrieved at [https://www.cesifo-group.de/ifoHome/publications/working-papers/CESifoWP/CESifoWPdetails?wp\\_id=19236491](https://www.cesifo-group.de/ifoHome/publications/working-papers/CESifoWP/CESifoWPdetails?wp_id=19236491)
- Anderson, J. E., and Van Wincoop, E. (2003). Gravity with gravitas: a solution to the border puzzle. *The American Economic Review*, 93(1), 170-192. DOI: 10.1257/000282803321455214
- Baier, S. L., & Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade?. *Journal of international Economics*, 71(1), 72-95. DOI: 10.1016/j.jinteco.2006.02.005
- Baldwin, R. (2011). 21<sup>st</sup> Century Regionalism: Filling the gap between 21<sup>st</sup> century trade and 21<sup>st</sup> and 20<sup>th</sup> century trade rules. *CEPR Policy Insight*, No. 56.

- Baldwin, R. (2012). WTO 2.0: Global governance of supply-chain trade. *CEPR Policy Insight*, No. 64. Retrieved at [http://www.cepr.org/sites/default/files/policy\\_insights/PolicyInsight64.pdf](http://www.cepr.org/sites/default/files/policy_insights/PolicyInsight64.pdf)
- Copeland, B. and Mattoo, A. (2008). The Basic Economics of Services Trade. Mattoo, A., Stern, R. M., and Zanini, G. (Ed.). A handbook of international trade in services (pp. 84-132). New York, US: Oxford University Press.
- De Backer, K. and Miroudot, S. (2013). Mapping global value chains. *OECD Trade Policy Papers*, No. 159, OECD Publishing, Paris. DOI: 10.1787/5k3v1trgnbr4-en
- De Sousa, J. (2012). The currency union effect on trade is decreasing over time. *Economics Letters*, 117(3), 917-920. DOI: 10.1016/j.econlet.2012.07.009
- Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M.P. and de Vries, G.J. (2013). The construction of World Input-Output Tables in the WIOD Project. *Economic Systems Research*, 25, 71-98. DOI: 10.1080/09535314.2012.761180
- Disdier, A-C. and Head, K. (2008). The Puzzling Persistence of the Distance Effect on Bilateral Trade. *Review of Economics and Statistics*, 90(1):37-48.
- Fally, T. (2015). Structural gravity and fixed effects. *Journal of International Economics*, 97(1), 76-85. DOI: org/10.1016/j.jinteco.2015.05.005
- Francois, F. and Pindyuk, O. (2013). Consolidated data on international trade in services. *IIDE Discussion Paper*, No. 20130101. Institute for International and Development Series.
- Francois, J., and Hoekman, B. (2010). Services trade and policy. *Journal of Economic Literature*, 48(3), 642-692. DOI: 10.1257/jel.48.3.642
- Francois, J., and Woerz, J. (2008). Producer services, manufacturing linkages, and trade. *Journal of Industry, Competition and Trade*, 8(3-4), 199-229. DOI: 10.1007/s10842-008-0043-0
- Francois, J., Manchin, M., and Tomberger, P. (2015). Services linkages and the value-added content of trade. *The World Economy*, 38(11), 1631-1649. DOI:10.1111/twec.12307
- Geloso, M. G., Gonzales, F., Miroudot, S., Nordås, H. K., Rouzet, D. and Ueno, A. (2015). Services Trade Restrictiveness Index (STRI): Scoring and Weighting Methodology. *OECD Trade Policy Papers*, No. 177, OECD Publishing, Paris. DOI: 10.1787/5js7n8wbtk9r-en
- Grünfeld, L. A., and Moxnes, A. (2003). The intangible globalization: Explaining the patterns of international trade in services. *NUPI Working Paper*, No 657.
- Head, K. and Mayer, T. (2014). Gravity Equations: Workhorse, Toolkit, and Cookbook. Chapter 3 in the Handbook of International Economics Vol. 4. Gopinath, H., Helpman, E. and Rogoff, K.S. (eds.). Oxford: Elsevier Ltd.
- Hummels, D., Ishii, J., and Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54(1), 75-96. DOI:10.1016/S0022-1996(00)00093-3
- IMF (2016). Global trade: What's behind the slowdown? *World Economic Outlook*, Chapter 2, October. Retrieved at <https://www.imf.org/external/pubs/ft/weo/2016/02/pdf/text.pdf>
- Johnson, R. C. (2014). Five facts about value-added exports and implications for macroeconomics and trade research. *Journal of Economic Perspectives*, 28(2), 119-142. DOI:10.1257/jep.28.2.119
- Johnson, R. C., and Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value-added. *Journal of International Economics*, 86(2), 224-236. DOI: 10.1016/j.jinteco.2011.10.003
- Kimura, F., and Lee, H. H. (2006). The gravity equation in international trade in services. *Review of world economics*, 142(1), 92-121. DOI: 10.1007/s10290-006-0058-8

- Koopman, R., Wang, Z., and Wei, S. J. (2014). Tracing value-added and double-counting in gross exports. *The American Economic Review*, 104(2), 459-494. DOI: 10.1257/aer.104.2.459
- Kowalski, P., Gonzales, J. L., Ragoussis, A., and Ugarte, C. (2015). Participation of developing countries in global value chains. Implications for trade and trade-related policies. *OECD Trade Policy Papers*, No. 179. OECD Publishing. DOI: 10.1787/5js33lwf0xxn-en
- Kox, H. and Nordås, H.K. (2009). Quantifying regulatory barriers to services trade. *OECD Trade Policy Papers*, No. 85, OECD Publishing, Paris.
- Kox, H. L. and Nordås, H. K. (2007). Services trade and domestic regulation. *MPRA paper No. 2116*. OECD Trade Directorate and CPB Netherlands Bureau for Economic Policy Analysis. Retrieved at <https://ub.uni-muenchen.de/id/eprint/2116>
- Kox, H. L. and Nordås, H. K. (2009). Regulatory harmonization and trade in services: Volumes and choice of mode. Retrieved at [https://www.researchgate.net/profile/Hildegunn\\_Nordas/publication/265285159\\_Regulatory\\_Harmonization\\_and\\_Trade\\_in\\_Services\\_Volumes\\_and\\_Choice\\_of\\_Mode/links/547c4b7c0cf293e2da2da575.pdf](https://www.researchgate.net/profile/Hildegunn_Nordas/publication/265285159_Regulatory_Harmonization_and_Trade_in_Services_Volumes_and_Choice_of_Mode/links/547c4b7c0cf293e2da2da575.pdf)
- Kox, H., and Lejour, A. M. (2005). Regulatory heterogeneity as obstacle for international services trade. *CPB Netherlands Bureau for Economic Policy Analysis*. Retrieved at <https://ideas.repec.org/p/cpb/discus/49.html>
- Leontief, W. W. (1936). Quantitative Input and Output Relations in the Economic Systems of the United States. *The Review of Economics and Statistics*, 18(3), 105-125. DOI:10.2307/1927837
- Marchetti, J. A., and Roy, M. (2014). The TISA initiative: an overview of market access issues. *Journal of World Trade*, 48(4), 683-728.
- Marel, E., and Shepherd, B. (2013). Services trade, regulation and regional integration: evidence from sectoral data. *The World Economy*, 36(11), 1393-1405. DOI: 10.1111/twec.12083
- Mattoo, A., and Fink, C. (2004). Regional agreements and trade in services: policy issues. *Journal of Economic Integration*, 742-779. DOI: 10.1111/twec.12083
- Miroudot, S. (2016). Services in global value chains: from inputs to value-creating activities. Preliminary draft, 4 March 2016, OECD. Retrieved at <http://rigvc.uibe.edu.cn/docs/20160329212106549903.pdf>
- Nordås, H. and D. Rouzet (2015). The Impact of Services Trade Restrictiveness on Trade Flows: First Estimates. *OECD Trade Policy Papers*, No. 178, OECD Publishing, Paris. DOI: 10.1787/5js6ds9b6kjb-en
- Nordås, H. K. and Rouzet, D. (2016). The Impact of Services Trade Restrictiveness on Trade Flows. *The World Economy*. DOI:10.1111/twec.12424
- Nordås, H. (2016). Services Trade Restrictiveness Index (STRI): The Trade Effect of Regulatory Differences. *OECD Trade Policy Papers*, No. 189, OECD Publishing, Paris. DOI: 10.1787/5jlz9z022plp-en
- OECD (2014). OECD Services Trade Restrictiveness Index (STRI) Policy Brief. Retrieved at [http://www.oecd.org/tad/services-trade/STRI%20Policy%20Brief\\_ENG.pdf](http://www.oecd.org/tad/services-trade/STRI%20Policy%20Brief_ENG.pdf)
- OECD (2015a). Measuring Trade in Value Added: An OECD-WTO joint initiative. Retrieved at <http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm>
- OECD (2015b). TiVA 2015 indicators – Definitions. Version 2. Retrieved at [https://www.oecd.org/sti/ind/tiva/TIVA\\_2015\\_Indicators\\_Definitions.pdf](https://www.oecd.org/sti/ind/tiva/TIVA_2015_Indicators_Definitions.pdf)
- OECD-WTO (2015a). Trade in value-added: Norway. Version 1. Retrieved at [https://www.oecd.org/sti/ind/tiva/CN\\_2015\\_Norway.pdf](https://www.oecd.org/sti/ind/tiva/CN_2015_Norway.pdf)
- OECD-WTO (2015b). OECD/WTO Trade in value-added (TIVA) indicators. Norway. Retrieved at [http://www.oecd.org/sti/ind/TiVA\\_NORWAY\\_MAY\\_2013.pdf](http://www.oecd.org/sti/ind/TiVA_NORWAY_MAY_2013.pdf)

- Puzello, L. (2012). A proportionality assumption and measurement biases in the factor content of trade. *Journal of International Economics*, 87(1), 105-111. DOI: 10.1016/j.jinteco.2011.11.009
- Roy, M. (2016). Charting the evolving landscape of services trade policies: Recent patterns of protections and liberalization. Sauvé, P. and Roy, M. (Ed.). *Research Handbook on Trade in Services* (pp. 66-84). Cheltenham, UK: Edward Elgar Publishing Limited. DOI: 10.4337/9781783478064
- Roy, M., Marchetti, J. and Lim, H. (2007). Services liberalization in the new generation of preferential trade agreements (PTAs): how much further than the GATS? *World Trade Review*, 6(2), pp. 155-192. DOI: 10.1017/S1474745607003217
- Silva, J. S., and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 88(4), 641-658. DOI: 10.1162/rest.88.4.641
- Solaz, M. A. (2016). Cadenas globales de valor y generación de valor añadido: El caso de la economía española. *Working Papers. Series EC*, 2016, 01. DOI: 10.12842/WPASEC-2016-01
- Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015). An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production. *Review of International Economics*, 23: 575–605. DOI: 10.1111/roie.12178View
- Timmer, M. P., Erumban, A. A., Los, B., Stehrer, R., and de Vries, G. J. (2014). Slicing Up Global Value Chains. *The Journal of Economic Perspectives*, 28(2), 99-118. DOI: 10.1257/jep.28.2.99
- Timmer, M. P., Los, B., Stehrer, R. and de Vries, G. J. (2016). An anatomy of the Global Trade Slowdown based on the WIOD 2016 Release. *GGDC Research Memorandum*, No 162. Retrieved at <http://www.ggdc.net/publications/memorandum/gd162.pdf>
- Timmer, M. P., Los, B., Stehrer, R. and de Vries G.J. (2013). Fragmentation, Incomes and Jobs: An analysis of European Competitiveness. *Economic Policy*, 28, 613-661. DOI: 10.1111/1468-0327.12018
- UNCTAD (2004). World Investment Report 2004. The Shift Towards Services. *United Nations Publication*. Retrieved at [http://unctad.org/en/Docs/wir2004\\_en.pdf](http://unctad.org/en/Docs/wir2004_en.pdf)
- Walsh, K. (2008). Trade in Services: Does Gravity Hold? *Journal of World Trade*, 42(2), 315-334. ISSN: 1011-6702
- Wang, Z., Wei, S.-J., and Zhu, K. (2013). Quantifying international production sharing at the bilateral and sector levels. *NBER working paper, No. 19677*. National Bureau of Economic Research. Retrieved at <http://www.nber.org/papers/w19677>
- WTO (2015). Trade in Services. Retrieved at [https://www.wto.org/english/thewto\\_e/20y\\_e/services\\_brochure2015\\_e.pdf](https://www.wto.org/english/thewto_e/20y_e/services_brochure2015_e.pdf)
- Yotov, Y., Piermartini, R., Monteiro, J-A. and Larch, Mariod (2016). An Advanced Guide to Trade Policy Analysis: The Structural Gravity Equation. WTO Publications.